REMARKS

Preferred embodiments of applicants' invention are directed to a fast scanning stage for a scanning probe microscope and a method of operating such a fast scanning stage. The scanning probe microscope includes a probe, and the stage comprises at least one fixed support and a sample stage having at least one axis of translation. As described in applicants' specification at page 7, paragraph [0024], the sample stage is affixed to the at least one fixed support by means for causing displacement of the stage relative to the probe. In a preferred form, the means for causing relative displacement comprises at least one, and most preferably four, actuator elements that are attached to the sample stage through the fixed support. The actuator element or elements are preferably driven at the resonant frequency of the sample stage to permit fast line scans at a rate of several kHz which are free from turn around artifacts. Compare the "ringing" motion of prior art devices (see, Fig. 1D and paragraphs [0009] and [0010]) with the motion of applicants' scanning stage (Figs. 3A and 3B).

In the first Office Action, the Examiner rejected claims 1, 2, 4, 12, 13, and 14 under 35 USC §102 as anticipated by Yasuda et al (US 6459088). Yasuda is directed to a drive stage for a scanning probe microscope comprising a pair of mechanical stages which are driven by actuator elements. Specific embodiments of Yasuda, for example the embodiments shown in Figs. 5 and 6, show a pair of mechanical stages (101 and 201, and 202 and 203, respectively) driven by one or more piezoelectric actuators (106 and 206, 207). The stages are supported from a fixed support (101 and 201) using springs (104 and 105, and 204 and 205, respectively). As taught by Yasuda, the drive signals to the piezo actuator elements are provided in a way that causes the inertial forces of the pair of stages to be offset and cancelled. That is, Yasuda requires the use of two masses which are driven in such a manner as to generate opposing inertial forces that cancel one another. See, e.g., col. 6, lines 48-54, and col. 7, lines 23-27. Other embodiments operate in a similar manner, namely, driving a pair of masses to generate opposing inertial forces that cancel one another. See, e.g., col. 11, lines 48-54.

Applicants' fast scanning stage structure and method of operation differ from that of Yasuda in several significant ways. Applicants have amended claims 1, 4, 12, and 13 to clarify the structural and operational distinctions. As shown and described with reference to the

embodiment of the invention in Figs. 2A and 2B, applicants' fast scanning stage includes at least one, and preferably two, fixed supports, and a sample stage having at least one axis of translation. The sample stage is affixed to the supports by actuator elements which cause displacement of the stage relative to the probe. The actuator elements are driven in unison, and preferably at the frequency of resonant vibration corresponding to the translation of the sample with respect to the probe.

Applicants do not require a pair of opposing masses to be driven in a manner that generates opposing inertial forces. Further, Yasuda suspends his pair of opposing masses from springs, and the masses are then driven by piezo actuators. Applicants' construction uses the actuator elements to support the sample stage from a fixed support. Both the construction and operation of the fast scanning stage differ from what is described by Yasuda. Specifically, with respect to claims 1 and 12, Yasuda fails to teach or suggest a structure in which a fast scanning stage comprises "at least one fixed support, and a sample stage having at least one axis of translation, said sample stage being affixed to said at least one fixed support by means for causing displacement of said stage relative to said probe" or a "fast scanning stage comprising at least one fixed support, and a sample stage having at least one axis of translation, said sample stage being affixed to said at least one fixed support by at least one actuator element supporting said stage to cause displacement of said stage relative to said probe."

With respect to amended claims 4 and 13, in the Office Action the Examiner asserted that Yasuda disclosed "driving the stage at resonant frequency relative to the probe (column 5, 16-20)." What Yasuda actually teaches is that the moving parts of the device are driven by an actuator such that their movements are offset to cancel opposing inertial forces, resulting in vibration free operation. See claim 1, col. 5, lines 15-20, and col. 7, lines 12-33. There is no mention of driving any mechanical stage at a resonant frequency relative to the probe, except in the context of equalizing the resonance frequencies of two masses or stages to provide cancellation of opposing inertial forces.

Applicants do not operate with pairs of stages or masses operated so as to cancel opposing inertial forces. Further, applicants' claims 4 and 13 recite that the fast scanning stage is driven at its resonant frequency using a sinusoidal waveform generator. As explained in applicants' specification at page 8, paragraphs [0026] and [0027], the response of the scanning

stage is also sinusoidal with no spurious resonance. Thus, because the derivative of the driving force is a smooth co-sinusoidal function with no impulse applied at the turning points of the raster scan, the claimed scanning stage and method of operation provide a device that completes fast line scans at a rate of several KHz, but which is free of scan turnaround artifacts. Compare prior art "ringing" at scan turn around points (Fig. 1D) with the drive waveform and scanning stage response of applicants' fast scanning stage (Figs. 3A and 3B).

For all of these reasons, applicants submit that Yasuda does not teach or suggest the subject matter presently claimed in claims 1, 2, 4, 12, 13, and 14. Applicants request reconsideration and withdrawal of the rejection.

Also in the first Office Action, the Examiner rejected claims 1 and 11 under 35 USC §102 as anticipated by Marchman (US 5811796). However, Marchman relates to an optical probe microscope in which the "probe" is an optical fiber that emits light onto a sample surface. With respect to amended claim 1, Marchman does not teach or suggest a fast scanning stage which comprises "at least one fixed support, and a sample stage having at least one axis of translation, said sample stage being affixed to said at least one fixed support by means for causing displacement of said stage relative to said probe." Applicants request reconsideration and withdrawal of this rejection.

Also in the first Office Action, the Examiner rejected claim 3 under 35 USC §103 as unpatentable over Yasuda in view of Shirai (6229607). The Examiner conceded that Yasuda did not teach the use of four actuators to displace the sample stage, but asserted that it would have been obvious to modify Yasuda in view of Shirai because Shirai did show the use of four actuators to move a sample stage in the X- and Y-directions.

Initially, applicants note that Yasuda does show an embodiment that uses four actuators, namely Embodiment 5, Figs. 14 and 15, cols. 11-12. However, again the actuators are used to drive four mechanical support stages in a manner which cancels opposing inertial forces generated by movement of the mechanical stages. Such a construction does not teach or suggest the claimed subject matter. Further, there would be no need to modify Yasuda with Shirai because Yasuda describes an embodiment in which drive signals are provided for both the X- and Y-directions.

Applicants also note that claim 3 depends indirectly from amended claim 1. Applicants submit that neither Yasuda, nor Shirai, nor any combination thereof, teach or suggest the presently claimed subject matter. As discussed above, Yasuda does not teach or suggest a structure in which a fast scanning stage comprises "at least one fixed support, and a sample stage having at least one axis of translation, said sample stage being affixed to said at least one fixed support by means for causing displacement of said stage relative to said probe." Further, while the Examiner has posited the obviousness of modifying the Yasuda microscope to provide four actuators, applicants note that the geometry and operation of Yasuda are directed to the pairing of masses (mechanical stages) such that the masses are driven by an actuator or actuators in opposing directions in order to cancel inertial forces. The Examiner has not explained exactly how Shirai's construction could or would be implemented by Yasuda. And, as noted above, Yasuda already teaches a four actuator embodiment that is different in construction and operation from that of Shirai as well as applicants. For all of these reasons, applicants request reconsideration of this rejection and withdrawal thereof.

Also in the first Office Action, the Examiner rejected claims 5 and 6 under 35 USC §103 as being unpatentable over Yasuda in view of Shirai, and taken further with Wakui (JP 085176). Claim 7 was rejected under 35 USC §103 as being unpatentable over Yasuda in view of Shirai, and taken further with Wakui and Elings (RE37560). Applicants note that claims 5-7 depend directly or indirectly from claim 3 (which itself depends indirectly from claim 1). Solely for the purpose of simplifying this response, applicants will rely on their arguments as discussed in detail above with respect to the patentability of amended claims 1 and 3. Because claims 5-7 depend from claims 1 and 3, applicants submit that they are patentable for the same reasons that claims 1 and 3 are patentable. Applicants do not concede that either of these grounds of rejection is proper, that the reference teachings can be combined as proposed, or that even if combined, would result in the claimed subject matter.

Also in the first Office Action, the Examiner rejected claim 8 under 35 USC §103 as being unpatentable over Yasuda in view of Elings. Claim 9 was rejected under 35 USC §103 as being unpatentable over Yasuda in view of Zdeblick (US4906840). Claim 10 was rejected under 35 USC §103 as being unpatentable over Yasuda in view of Shirai, and taken further with Zdeblick. Applicants note that claims 8-10 depend directly or indirectly from claims 2 or 3

(which themselves depend directly or indirectly from claim 1). Solely for the purpose of simplifying this response, applicants will rely on their arguments as discussed in detail above with respect to the patentability of amended claims 1 and 3. Because claims 8-10 depend from claims 1 and 3, applicants submit that they are patentable for the same reasons that claims 1 and 3 are patentable. Applicants do not concede that either of these grounds of rejection is proper, that the reference teachings can be combined as proposed, or that even if combined, would result in the claimed subject matter.

Also in the first Office Action, the Examiner rejected claim 15 under 35 USC §103 as unpatentable over Yasuda in view of Ando. The Examiner conceded that Yasuda was silent with respect to operating the sample stage at a resonant frequency that was $1/100^{th}$ of the probe's resonant frequency. However, the Examiner asserted that Ando taught operation using a frequency ratio of "about $1/100^{th}$." Applicants note that claim 15 has been amended to depend from amended independent claim 13. Solely for the purpose of simplifying this response, applicants will rely on their arguments as discussed in detail above with respect to the patentability of amended claim 13. Because claim 15 depends from claim 13, applicants submit that claim 15 is patentable for the same reasons that claim 13 is patentable. Applicants do not concede that this ground of rejection is proper, that the reference teachings can be combined as proposed, or that even if combined, would result in the claimed subject matter.

For all of the above reasons, applicants submit that claims 1-13 and 15, as amended, are patentable over the cited prior art of record. Early notification of allowable subject matter is respectfully solicited.

Respectfully submitted,

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